# TECHNICAL NOTE 350

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

## SMALL MAMMALS OF THE BLACK CANYON AND SKULL VALLEY PLANNING UNITS

## MARICOPA AND YAVAPAI COUNTIES, ARIZONA

by

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U.S. Bureau of Land Management
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## ABSTRACT

Traditionally, past wildlife habitat management on public lands has been restricted to game species. Recent policy now dictates that all BLM-administered lands are to be inventoried for nongame species. The first nongame inventory was completed during the spring and summer of 1978 on two planning units in central Arizona comprising some 338,000 acres of public land. Vertebrate species were surveyed for relative density, species diversity, and distribution. During the course of this study a total of 50 mammal species were either collected or observed. Trapping methods closely followed that of Calhoun (1951) and more than 18,000 trap nights were accumulated. Relative densities for 19 different species collected along trap lines were determined within eight plant communities of the Sonoran Desert. Distribution and density data clearly demonstrate the ability of mammal species to overlap habitat and reveal general trends as to habitat preference. Desertscrub and wash communities were the most productive habitats for small mammals. They supported the highest relative densities and the highest number of species. In contrast, the more mesic habitats, such as riparian woodlands and interior chaparral, were the least productive habitats sampled.

## ACKNOWLEDGEMENTS

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# INTRODUCTION

The vertebrate fauna (excluding Osteichthyes) of the Black Canyon and Skull Valley Planning Units was surveyed during the spring and summer of 1978 for relative density, species diversity, and distribution.

Traditionally, past wildlife habitat management on public lands has been restricted to game species. Recent legislation dictates that all BLM-administered lands are to be inventoried for nongame species. The Integrated Habitat Inventory and Classification System (IHICS) is the current wildlife data collecting and habitat analysis system for environmental assessment of wildlife resources and management of public lands. It is to serve as the baseline information source at the policy making level.

## DESCRIPTION OF THE STUDY AREA

Location. The survey was conducted on two BLM-administered planning units northwest of Phoenix in Maricopa and Yavapai counties. Together the Black Canyon and Skull Valley Planning Units comprise 338,000 acres of public land, 256,000 acres and 82,000 acres respectively (Fig. 1).

Topography. Topography within the two planning units varies from desert flatlands, foothills, and mesas, to low elevation mountains. These landforms are highly dissected by intermittent drainages throughout the study area and many form narrow canyons of high relief. Soils vary from fine alluvial sediments to large granite pegmatites. Elevation ranges from approximately 1,200 to 5,800 feet.

Climate. The study area is characterized by a warm, arid climate typical of the Sonoran Desert. Total annual precipitation is variable, but generally follows the bimodal pattern of winter and summer precipitation with spring and fall drought. Table 1 shows the mean daily maximum and minimum temperatures for the months of April through August from four recording stations located within the planning units. Locations and elevations of climatological stations are given in Appendix 1. Daily temperatures fluctuate greatly as exemplified in actual monthly highs and lows recorded during the time of study and listed in Table 2.

Considerable disparity exists in comparing the monthly precipitation during the 1978 study period to the mean monthly precipitation records (Table 3). The 1978 hydrological cycle can best be described as an atypical year with higher than normal winter and spring precipitation. In contrast, summer precipitation recorded for the four stations was well below the annual norm.

Vegetation. The Black Canyon and Skull Valley Planning Units intergrade the Upper and Lower Sonoran Life-zones. Eight plant communities and eleven standard habitat sites were encountered within the two life-zones (Lowe and Brown 1973).

- Upper Sonoran Life-zone
  - Chaparral Community
  - Desert Grassland Community
- Lower Sonoran Life-zone
  - Sonoran Desertscrub
  - Lower Colorado Community
  - Arizona Upland Community

Fig. 1. LOCATION OF SKULL VALLEY AND BLACK CANYON PLANNING UNITS, YAVAPAI AND MARICOPA COUNTIES.

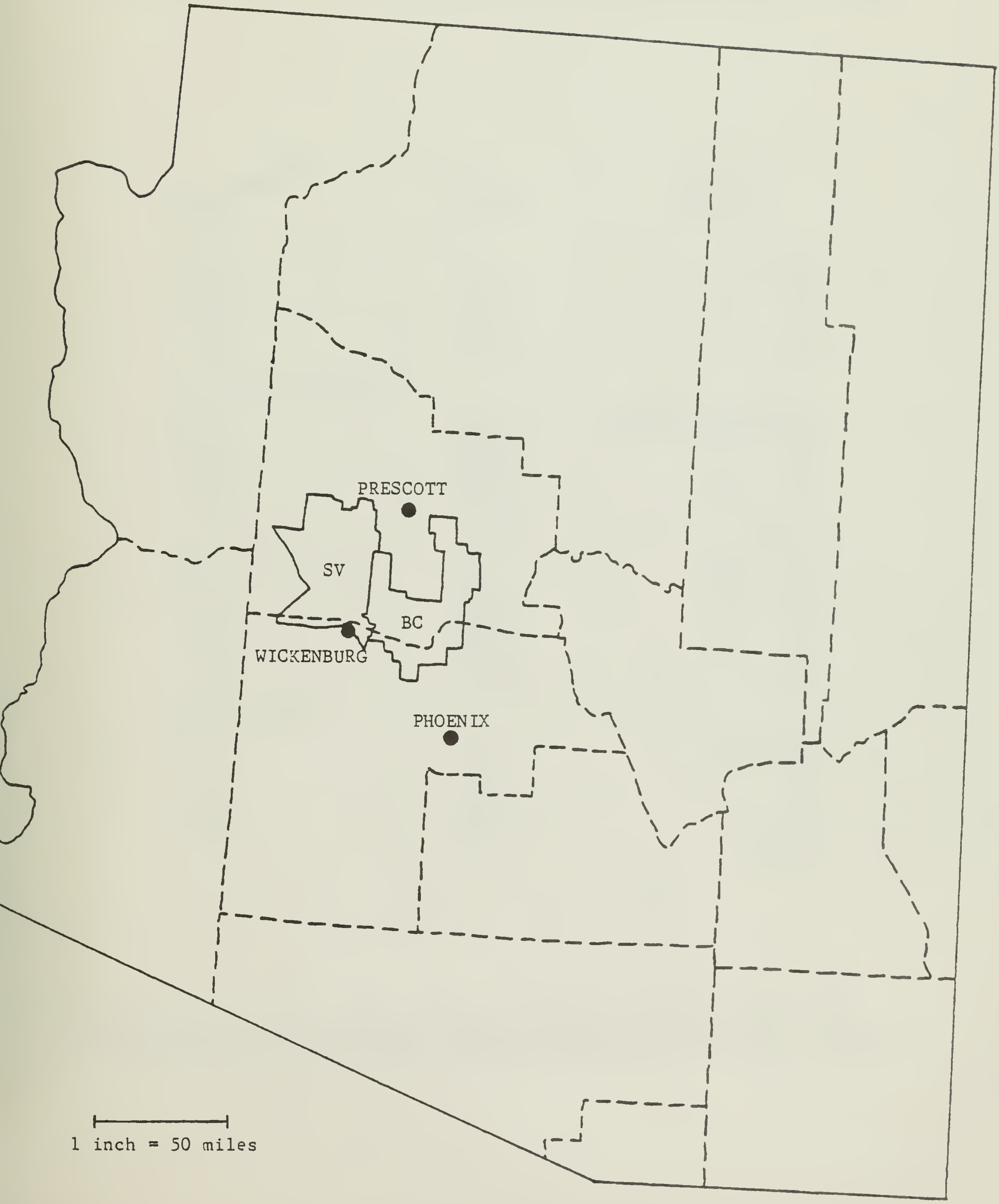

TABLE 1. MEAN DAILY MAXIMUM AND MINIMUM TEMPERATURES FOR THE MONTHS OF APRIL THROUGH AUGUST IN °F. *

| STATION | MAXIMUM | MINIMUM |
|---|---|---|
| Cordes | | |
| April | 72.5 | 42.0 |
| May | 81.5 | 49.0 |
| June | 90.6 | 56.9 |
| July | 95.4 | 65.7 |
| August | 92.3 | 64.6 |
| Castle Hot Springs | | |
| April | 80.7 | 51.1 |
| May | 90.2 | 59.0 |
| June | 98.7 | 68.2 |
| July | 103.3 | 76.4 |
| August | 100.4 | 74.5 |
| Wickenburg | | |
| April | 80.8 | 43.3 |
| May | 90.1 | 49.9 |
| June | 99.0 | 57.9 |
| July | 103.6 | 69.7 |
| August | 100.6 | 68.3 |
| Hillside | | |
| April | 74.4 | 39.3 |
| May | 80.1 | 43.8 |
| June | 89.8 | 52.8 |
| July | 94.5 | 62.4 |
| August | 93.3 | 60.3 |

* Arizona Climate 1931-1972, 2nd Edition. William D. Sellers and Richard H. Hill. University of Arizona Press; Tucson, Arizona 1974.

TABLE 2. MONTHLY TEMPERATURE EXTREMES FOR SPRING/SUMMER 1978 IN °F. *

| STATION | MAXIMUM | MINIMUM |
| --- | --- | --- |
| Cordes | | |
| April | 80 | 32 |
| May | 97 | 36 |
| June | 103 | 50 |
| July | 104 | 54 |
| August | 101 | 54 |
| Castle Hot Springs | | |
| April | 87 | 39 |
| May | 102 | 46 |
| June | 108 | 58 |
| July | 113 | 67 |
| August | 109 | 68 |
| Wickenburg | | |
| April | 92 | 34 |
| May | 106 | 42 |
| June | 113 | 45 |
| July | 115 | 50 |
| August | 108 | 50 |
| Skull Valley | | |
| April | 77 | 27 |
| May | 90 | 32 |
| June | 97 | 40 |
| July | 102 | 44 |
| August | 96 | 47 |

* Arizona Climatological Data, Monthly Summaries, National Oceanic and Atmospheric Administration, Environmental Data Service, National Climatic Center; Asheville, North Carolina 1978.

TABLE 3. PRECIPITATION NORMAL, ACTUAL, AND DEPARTURE FROM NORMAL IN INCHES FOR SPRING/SUMMER 1978.

| | NORMAL | ACTUAL | DEPARTURE | AVERAGE PPT/YEAR |
|---|---|---|---|---|
| Cordes | | | | |
| April | .68 | .80 | +.12 | |
| May | .30 | .24 | -.06 | |
| June | .29 | T | -.29 | 13.54 |
| July | 1.77 | .99 | -.78 | |
| August | 2.54 | 1.70 | -.84 | |
| Castle Hot Springs | | | | |
| April | .49 | .72 | +.23 | |
| May | .17 | .33 | +.16 | |
| June | .22 | - | -.22 | 15.07 |
| July | 1.06 | 1.02 | -.04 | |
| August | 2.87 | 1.57 | -1.30 | |
| Wickenburg | | | | |
| April | .50 | .89 | +.39 | |
| May | .15 | .25 | +.10 | |
| June | .17 | - | -.17 | 10.77 |
| July | 1.21 | .36 | -.85 | |
| August | 2.24 | .28 | -1.96 | |
| Skull Valley | | | | |
| April | | 1.35 | | |
| May | | .54 | | |
| June | | T | | |
| July | | 1.46 | | |
| August | | .95 | | |
| Hillside | | | | |
| April | .97 | | | |
| May | .22 | | | |
| June | .06 | | | 13.52 |
| July | 1.04 | | | |
| August | 2.09 | | | |

Riparian Deciduous Woodland
- Mesquite/Acacia Bosque Community
- Mixed Broadleaf Community
- Cottonwood/Willow Community
- Mixed Riparian Scrub Community

Standard habitat sites are given in Appendix 2.

Chaparral Community. Chaparral generally occurs between 4,000 and 6,000 feet in elevation and where precipitation ranges between 13 and 23 inches annually (Lowe 1964).

Chaparral communities are generally characterized by dense shrubby growth of low uniform height. Grasses are scarce, except in broken areas, and plant diversity is low. Scrub oak (*Quercus turbinella*) is the most frequently encountered dominant within this community. It accounted for 28% cover along a representative transect, followed by buckbrush (*Ceanothus greggii*) 18%, wait-a-minute bush (*Mimosa biuncifera*) 17%, and skunkbush (*Rhus trilobata*) 14%.

Desert Grassland Community. Desert grassland in Arizona is generally a mixed grass/shrub type of community that occurs on shallow, rocky soils between 3,500 and 5,000 feet in elevation. It is one of the most highly diverse plant communities and often represents a grass-dominated transition between chaparral above and the desertscrub below. As a transitional area, desert grassland receives between 10 and 15 inches of precipitation annually. Snakeweed (*Gutierrezia sarothrae*) often comprises the highest percentage of cover. For example, in one transect it represented 29% cover followed by tobosa grass (*Hilaria mutica*) 27%, curly mesquite grass (*Hilaria belangeri*) 17%, and catclaw (*Acacia greggii*) 5%.

Sonoran Desertscrub. At lower elevations, desert grassland grades into the desertscrub of the Lower Sonoran Life-zone. In Arizona, total annual precipitation and elevation within this zone range from 3 to 11 inches precipitation and from 100 to approximately 4,000 feet in elevation (Lowe 1964).

Sonoran desertscrub can be further subdivided into two distinct communities: (1) Lower Colorado desert community, and (2) the Arizona Upland desert community (Lowe and Brown 1973).

Lower Colorado Community. Lower Colorado desert communities are most clearly represented by creosote bush (*Larrea tridentata*) flats in which trees are usually lacking and shrubs are dominant and widely scattered. Representative cover values found creosote bush comprising 55% cover and triangle-leaf bursage (*Ambrosia deltoidea*) at 16%. This is a climax community which is characterized by alkaline soils of fine texture within low desert basins.

Arizona Upland Community. Arizona Upland is best represented by palo verde-saguaro (*Cercidium-Cereus*) desertscrub. In this community,

plants are comprised of small-leaved trees, as well as shrubs and numerous cacti. Best development is attained on rocky hills and coarse-soiled slopes, i.e. the bajada, where the substratum is on or near the parent bedrock material. Plant morphology is highly diverse with leafless, drought deciduous, and evergreen species, thereby making it the most structurally diverse vegetational community encountered. Community biomass and productivity are greater here than in the creosote bush communities on the valley fill of the plains below. Shrubs are more varied than the trees, and although the foothill understory may be predominantly of a single species, e.g. triangle-leaf bursage or brittlebush (Encelia farinosa), it is often comprised of a mixture of 5 to 15 or more shrub species in the form of a layered understory. Some representative cover values for a south-facing foothill include the following: brittlebush 33%, creosote bush 13%, triangle-leaf bursage 11%, foothill palo verde (Cercidium microphyllum) 9%, and saguaro (Cereus giganteus) at 0%. The low cover value for the saguaro is due to its vertical growth form and therefore results in low percent cover values by the line intercept method. Actual importance of saguaro is probably greater than these low values would indicate.

Riparian Deciduous Woodland. Riparian habitats are distinct biotic communities associated with perennial or intermittent watercourses. They are unique reservoirs of plant and animal diversity which extend from the desertscrub of the Lower Sonoran to the fir forests of the Canadian Life-zone. These habitats consist of different life-forms or species other than those of the immediately surrounding nonriparian climax.

Because riparian communities generally exhibit a predictable vertical zonation where composition and form of the riparian woodland changes with elevation, this biome can be subdivided into four major communities: (1) mesquite/acacia bosque, (2) mixed broadleaf community, (3) cottonwood/willow community, and (4) the mixed riparian scrub community.

Mesquite/Acacia Bosque Community. Mesquite (Prosopis velutina)/catclaw bosques are vegetated by thick, forest-like stands of winter deciduous microphylls. Bosques in Arizona are largely restricted to elevations below 3,500 feet where they attain maximum development on the alluvium of old flood plains.

Historically, riparian stands were once extensive throughout the state but have since been reduced or eliminated by past and present land management. It is estimated that riparian areas in Arizona comprise only 179,600 acres, of which 100,700 acres are adjacent to the Gila River (Babcock 1968).

Cover values from a transect located within a mesquite bosque found mesquite representing 35% cover and catclaw 20%.

Mixed Broadleaf Community. Mixed broadleaf communities are usually found in Arizona along perennial or seasonally intermittent streams

between 3,500 and 6,500 feet in elevation (Brown *et al.* 1977). It is the riparian community that transects chaparral and is composed of broadleaf species such as Arizona walnut (*Juglans major*), Emory oak (*Quercus emoryi*), white oak (*Quercus arizonica*), and velvet ash (*Fraxinus pennsylvanica*). Cover values obtained from a transect located along Arrastre Creek were representative for the community. It was found here that velvet ash represented more than 25% cover, followed by canyon grape (*Vitis arizonica*) 17%, Arizona walnut 12%, and Emory oak 11%.

*Cottonwood/Willow Community*. At elevations below 3,500 feet, riparian habitats adjacent to desert grassland are generally dominated by cottonwood (*Populus fremontii*), Goodding willow (*Salix gooddingii*), sycamore (*Plantanus wrightii*), and net-leaf hackberry (*Celtis reticulata*), thereby forming a distinct climax community. A representative example of cover values obtained from this type of community found sycamore to be dominant at 18%, followed by velvet ash 15%, and net-leaf hackberry 11%.

*Mixed Riparian Scrub Community*. Riparian scrub is the vegetational community limited to the desert washes or arroyos. Life-form is variable between deciduous microphylls such as members of the leguminosae (palo verde, mesquite, ironwood, and catclaw) to broader leaved species, *e.g.* canyon ragweed (*Ambrosia ambrosioides*). These communities occur over a variety of sand to rubble-bottomed substrata along intermittent drainages. Some representative cover values obtained from a low-desert wash found wolfberry (*Lycium* sp.) most frequently encountered at 35% followed by catclaw 17%, blue palo verde (*Cercidium floridum*) 10%, and ironwood (*Olneya tesota*) 6%.

## METHODS

General distribution information on small mammals is available (Burt and Grossenheider 1952, Hall and Kelson 1959, and Cockrum 1960), but specific information on densities and distribution of species is virtually nonexistent for the Black Canyon and Skull Valley Planning Units.

Small mammals were sampled at 64 separate localities during the season of highest activity, late spring through summer. Locational descriptions of the transects are given in Appendix 3 and 4 by section number and map coordinates. Densities were determined by extensive grid trapping in the eight major vegetative communities that occur within the study area. Each grid consisted of two parallel lines 50 feet apart with 15 trapping stations per line. On each line, stations were located 50 feet apart with 3 traps at each station (two museum specials and one rat trap) totalling 90 traps per grid (modified after Calhoun 1951). Each grid was trapped three consecutive nights and traps were baited with a mixture of peanut butter, oatmeal, and dimethyl pthalate, an ant repellent (Anderson and Ohmart 1977).

Because the area trapped cannot be accurately determined for snap trapping, small mammal densities for transects are expressed in terms of captures per trap night, calculated as the number of each species caught per 270 trap nights (3 consecutive nights x 90 traps set per night). Relative abundance was estimated from frequency of occurrence for mammals observed but not trapped along transects, e.g. game animals, bats, and large-bodied animals which do not lend themselves readily to this method of trapping or size of traps. Additional information on mammals was obtained through museum records, sight records, observation of sign, shooting, mist netting, can traps, and selective trapping either of special habitat features or with special traps, e.g. macabee gopher traps.

A representative collection of skins and skulls prepared as voucher specimens from the animals trapped are on deposit at the Phoenix District Office of the Bureau of Land Management, Museum of Northern Arizona (Flagstaff), and the University of Arizona, Department of Ecology and Evolutionary Biology, Collection of Mammals (Tucson). Identifications followed Jones *et al*. 1975.

## RESULTS

Arizona displays a diverse assemblage of southwestern vertebrates; it supports 134 different mammal species which represent 41.6% of the total North American mammalian fauna north of Mexico (Hubbard 1977). During the sampling period of April through August, 1978, a total of 38 species were collected and an additional 12 were observed for the Black Canyon and Skull Valley Planning Units (Tables 4 and 5).

A total of 64 trapping grids was utilized in the survey (52 on Black Canyon and 12 for Skull Valley) in which 444 small mammals comprising 19 species were collected. Species composition and relative abundance of the small mammals collected by snap trapping are summarized in Table 6 for each major plant community. Relative densities were determined from 16,020 of the accumulated 18,270 trap nights. Trapping success for the habitat sites considered was estimated at 2.77%.

The most abundant rodent was the white-throated woodrat (*Neotoma albigula*) which comprised 23% of the total mammals trapped and was present in nine out of the eleven standard habitat sites (Table 7). Other significantly abundant species were the rock pocket mouse (*Perognathus intermedius*) which accounted for 20.9%, Merriam's kangaroo rat (*Dipodomys merriami*) 13.7%, and the cactus mouse (*Peromyscus eremicus*) 11.2%. The remaining 15 species collected from trap lines were less abundant with percentages ranging from 0.2 to 7.4%.

It should be noted that density values per 270 trap nights listed in Table 6 and percentage totals in Table 7 are not representative for the sciurids and leporids. These two families are more abundant than the figures would indicate, but have been included here for completeness of data.

Sciurids are diurnally active animals and, although snap traps were set throughout the day, periods of high temperature and low moisture may have forced the large-bodied rodents into aestivation to reduce heat stress and water loss. This is already well documented for other Sonoran Desert rodents where depressed summer activity patterns were correlated with increased body weight (Reichman and Van de Graaff 1973). The fact that snap trapping was conducted during an extended period of elevated air temperatures in an arid habitat, coupled with the fact that some species because of their size, were not highly vulnerable to snap traps, may account for the reduced density figures.

Hares and rabbits are active throughout the summer and are extremely abundant in number, although the relative density figures would not suggest this. A compound problem exists where preference for herbaceous and succulent forage may render the bait unattractive to members of this family in addition to reduced capture due to large body size.

Mixed riparian scrub displayed the highest total relative density among all communities sampled (Table 6). Eleven species were collected

Table 4. MAMMAL SPECIES COLLECTED APRIL 1978 THROUGH AUGUST 1978.

| | |
|---|---|
| INSECTIVORA, Insectivores | |
| SORICIDAE, Shrews | |
| *Notiosorex crawfordi* | Desert shrew |
| CHIROPTERA, Bats | |
| PHYLLOSTOMATIDAE, Leaf-nosed bats | |
| *Macrotus waterhousi* | California leaf-nosed bat |
| VESPERTILIONIDAE, Plain-nosed bats | |
| *Myotis yumanensis* | Yuma myotis |
| *Myotis velifer* | Cave myotis |
| *Myotis thysanodes* | Fringed myotis |
| *Myotis californicus* | California myotis |
| *Pipistrellus hesperus* | Western pipistrelle |
| *Eptesicus fuscus* | Big brown bat |
| *Plecotus townsendi* | Townsend's big-eared bat |
| *Antrozous pallidus* | Pallid bat |
| MOLOSSIDAE, Freetail bats | |
| *Tadarida femorosacca* | Pocketed free-tailed bat |
| LAGOMORPHA, Hares and Rabbits | |
| LEPORIDAE, Hares and Rabbits | |
| *Lepus californicus* | Black-tailed jack rabbit |
| *Sylvilagus floridanus* | Eastern cottontail |
| *Sylvilagus audubonі* | Desert cottontail |
| RODENTIA, Rodents | |
| SCIURIDAE, Squirrels and Allies | |
| *Spermophilus variegatus* | Rock squirrel |
| *Spermophilus tereticaudus* | Round-tailed ground squirrel |
| *Ammospermophilus harrisi* | Yuma antelope squirrel |
| *Eutamias dorsalis* | Cliff chipmunk |
| GEOMYIDAE, Pocket gophers | |
| *Thomomys bottae* | Valley pocket gopher |
| HETEROMYIDAE, Kangaroo Rats and Pocket Mice | |
| *Perognathus longimembris* | Little pocket mouse |
| *Perognathus amplus* | Arizona pocket mouse |
| *Perognathus baileyi* | Bailey's pocket mouse |
| *Perognathus penicillatus* | Desert pocket mouse |
| *Perognathus intermedius* | Rock pocket mouse |
| *Dipodomys merriami* | Merriam's kangaroo rat |
| *Dipodomys ordi* | Ord's kangaroo rat |

| | |
|---|---|
| MURIDAE, Introduced Rats and Mice | |
| *Mus musculus* | House mouse |
| CRICETIDAE, Native Rats and Mice | |
| *Reithrodontomys megalotis* | Western harvest mouse |
| *Onychomys leucogaster* | Northern grasshopper mouse |
| *Onychomys torridus* | Southern grasshopper mouse |
| *Peromyscus eremicus* | Cactus mouse |
| *Peromyscus maniculatus* | Deer mouse |
| *Peromyscus leucopus* | White-footed mouse |
| *Peromyscus boylei* | Brush mouse |
| *Neotoma albigula* | White-throated wood rat |
| *Neotoma lepida* | Desert wood rat |
| *Neotoma stephensi* | Stephen's wood rat |
| CARNIVORA, Carnivores | |
| CANIDAE, Dogs and Allies | |
| *Urocyon cinereoargenteus* | Gray fox |
| MUSTELIDAE, Weasels, Skunks, and Allies | |
| *Spilogale gracilis* | Western spotted skunk |

Table 5. MAMMAL SPECIES OBSERVED APRIL 1978 THROUGH AUGUST 1978, BUT NOT COLLECTED.

| | |
|---|---|
| CARNIVORA, Carnivores | |
| CANIDAE, Dogs and Allies | |
| *Canis latrans* | Coyote |
| URSIDAE, Bears | |
| *Ursus americanus* | Black bear |
| PROCYONIDAE, Raccoons and Allies | |
| *Bassariscus astutus* | Ringtail |
| *Procyon lotor* | Raccoon |
| MUSTELIDAE, Weasels, Skunks, and Allies | |
| *Taxidea taxus* | Badger |
| *Mephitis mephitis* | Striped skunk |
| FELIDAE, Cats | |
| *Felis concolor* | Mountain lion |
| *Felis rufus* | Bobcat |
| ARTIODACTYLA, Even-toed Ungulates | |
| TAYASSUIDAE, Peccaries | |
| *Dicotyles tajacu* | Javelina |
| CERVIDAE, Deer and Allies | |
| *Odocoileus hemionus* | Mule deer |
| ANTILOCAPRIDAE, Antelope | |
| *Antilocapra americana* | Pronghorn antelope |
| PERISSODACTYLA, Odd-toed Ungulates | |
| EQUIDAE, Horses and Asses | |
| *Equus asinus* | Burro |

Table 6. SMALL MAMMAL DENSITIES FOR EACH MAJOR VEGETATION COMMUNITY.
DATA ARE SHOWN AS NUMBER OF ANIMALS CAPTURED PER 270 TRAP NIGHTS AND PARENTHESES INDICATE TOTAL NUMBER TRAPPED.

| Species | Mixed Riparian Scrub | Arizona Upland | Lower Colorado | Desert Grassland | Cottonwood /Willow | Chaparral | Mixed Broadleaf | Mesquite Acacia Bosque | Totals |
|---|---|---|---|---|---|---|---|---|---|
| *Dipodomys merriami* | 2.44 (13) | 1.21 (34) | 2.33 (7) | 0.25 (2) | 0.33 (1) | | | 1.0 (4) | 7.56 (61) |
| *Dipodomys ordi* | | | | | 0.33 (1) | 0.40 (2) | | | .73 (3) |
| *Perognathus amplus* | | 0.18 (5) | 3.33 (10) | | | | | | 3.51 (15) |
| *Perognathus baileyi* | 1.50 (8) | 0.86 (24) | | | | | | 0.25 (1) | 2.61 (33) |
| *Perognathus intermedius* | 1.69 (9) | 2.75 (77) | | | 0.67 (2) | | | 1.25 (5) | 6.36 (93) |
| *Perognathus longimembris* | 0.75 (4) | 0.18 (5) | | | | | | | .93 (9) |
| *Perognathus penicillatus* | 1.50 (8) | 0.36 (10) | | | | | | | 1.86 (18) |
| *Peromyscus eremicus* | 1.31 (7) | 0.76 (22) | 1.0 (3) | 1.75 (14) | 1.0 (3) | | 0.33 (1) | | 6.15 (50) |
| *Peromyscus leucopus* | | | | | | 0.20 (1) | 0.33 (1) | | .53 (2) |
| *Peromyscus maniculatus* | | | | 0.25 (2) | | 0.20 (1) | | | .25 (3) |
| *Onychomys torridus* | | | | 0.25 (2) | | | | | .25 (2) |
| *Neotoma albigula* | 2.25 (12) | 1.64 (46) | | 3.63 (29) | 0.67 (2) | 1.80 (9) | 1.33 (4) | | 11.32 (102) |
| *Neotoma lepida* | 0.19 (1) | 0.46 (13) | | 0.13 (1) | 0.33 (1) | 0.20 (1) | 1.0 (3) | | 2.31 (20) |
| *Neotoma stephensi* | | | | 0.13 (1) | | 0.20 (1) | | | .33 (2) |
| *Ammospermophilus harrisi* | 2.44 (13) | 0.32 (9) | 0.33 (1) | | | | | 0.25 (1) | 3.34 (24) |
| *Spermophilus tereticaudus* | 0.19 (1) | | | | | | | | .19 (1) |
| *Eutamias dorsalis* | | | | | 0.33 (1) | | | | .33 (1) |
| *Sylvilagus auduboni* | 0.19 (1) | 0.04 (1) | | | | 0.20 (1) | | | .43 (3) |
| *Sylvilagus floridanus* | | | | 0.13 (1) | | 0.20 (1) | | | .33 (2) |
| | | | | TOTALS | | | | | |
| Relative density | 14.45 | 8.76 | 6.99 | 6.52 | 3.66 | 3.40 | 2.99 | 2.75 | |
| Number of trap nights | 1,440 | 7,560 | 810 | 2,160 | 810 | 1,350 | 810 | 1,080 | 16,020 |
| Number of animals caught | 77 | 246 | 21 | 52 | 11 | 17 | 9 | 11 | 444 |
| Number of species | 11 | 11 | 4 | 8 | 7 | 8 | 4 | 4 | 19 |

Table 7. TOTAL CATCH PERCENTAGES AND HABITAT SELECTION OF THE MAMMAL SPECIES COLLECTED BY SNAP TRAPPING.

| Species | Percentage caught in all habitats with total number trapped in parentheses. | Habitat Utilization (Number of habitats the species was found in versus total number of habitats). |
|---|---|---|
| Dipodomys merriami | 13.7% (61) | 8/11 |
| Dipodomys ordi | 0.7% (3) | 2/11 |
| Perognathus amplus | 3.4% (15) | 2/11 |
| Perognathus baileyi | 7.4% (33) | 4/11 |
| Perognathus intermedius | 20.9% (93) | 6/11 |
| Perognathus longimembris | 2.0% (9) | 2/11 |
| Perognathus penicillatus | 4.0% (18) | 2/11 |
| Peromyscus eremicus | 11.2% (50) | 9/11 |
| Peromyscus leucopus | 0.5% (2) | 2/11 |
| Peromyscus maniculatus | 0.7% (3) | 2/11 |
| Onychomys torridus | 0.5% (2) | 1/11 |
| Neotoma albigula | 23.0% (102) | 9/11 |
| Neotoma lepida | 4.5% (20) | 7/11 |
| Neotoma stephensi | 0.5% (2) | 2/11 |
| Ammospermophilus harrisi | 5.4% (24) | 5/11 |
| Spermophilus tereticaudus | 0.2% (1) | 1/11 |
| Eutamias dorsalis | 0.2% (1) | 1/11 |
| Sylvilagus auduboni | 0.7% (3) | 3/11 |
| Sylvilagus floridanus | 0.5% (2) | 2/11 |

and the highest densities for Merriam's kangaroo rat, Bailey's pocket mouse (Perognathus baileyi), little pocket mouse (Perognathus longimembris), desert pocket mouse (Perognathus penicillatus), and Yuma antelope squirrel (Ammospermophilus harrisi) were recorded here. The most significant species, in terms of relative densities, appear to be the Merriam's kangaroo rat (2.44), Yuma antelope squirrel (2.44), and white-throated woodrat (2.25). In addition, two lagomorphs, the black-tailed jack rabbit (Lepus californicus) and especially, the desert cottontail (Sylvilagus auduboni) were observed to be abundant in their utilization of this habitat.

Small mammals are able to take full advantage of the variety this community provides in the form of substrate types and cover. Substrate varies from alluvial sand to loose talus on rocky shelves. Cover is provided from both the riparian desertscrub and the debris of intermittent flooding. Collectively, differences in life-form of the vegetation and topography form a structurally diverse community that supports the greatest number of species at the greatest population numbers.

The vegetational structure of Arizona Upland is similarly diverse and was found to support an equal number of species as mixed riparian scrub, but at reduced densities. The highest reported densities for the rock pocket mouse and desert woodrat (Neotoma lepida) were in desertscrub. In this community the highest recorded relative densities were for rock pocket mouse (2.75), white-throated woodrat (1.64), and Merriam's kangaroo rat (1.21). Black-tailed jack rabbits and desert cottontails were common in desertscrub habitat of Arizona Upland, and rock squirrels (Spermophilus variegatus) were locally common among rock outcrops. Round-tail ground squirrels (Spermophilus tereticaudus) were infrequently encountered as local populations on desert flatlands where mesquite and creosote bush occurred over sandy soils. None were collected by snap trapping. Coyotes (Canis latrans) were observed as being most numerous here than in any other vegetational community, presumably in response to the jack rabbit and cottontail populations. They usually occurred as isolated individuals whereas javelina (Dicotyles tajacu) formed small bands that were generally found in areas laden with prickly pear (Opuntia phaeacantha). Mule deer (Odocoileus hemionus) were occasionally sighted in open, more broken desertscrub where browse plants such as jojoba (Simmondsia chinensis) were abundant. Feral burros (Equus asinus) were only encountered in desertscrub communities. They occur as small herds in areas proximal to water sources, e.g. cattle tanks and springs, and were most numerous near Lake Pleasant Regional Park.

Arizona Upland was further subdivided into three standard habitat sites based on gradient. They included desertscrub flatlands, foothills, and hillsides. Many species key to the degree of inclination and the subsequent substrate types, rather than specific vegetational species. This is clearly illustrated in Table 8 where relative densities indicate that the Merriam's kangaroo rat shows habitat preference for areas of low relief with substrate consisting of loosely compacted

Table 8. SMALL MAMMAL DENSITIES FOR THE SONORAN DESERTSCRUB COMMUNITIES. DATA ARE SHOWN AS NUMBER OF ANIMALS CAPTURED PER 270 TRAP NIGHTS AND PARENTHESES INDICATE TOTAL NUMBER TRAPPED.

| Species | Flatland | Foothill | Hillside | Totals |
|---|---|---|---|---|
| *Dipodomys merriami* | 2.6 (26) | 0.69 (8) | | 3.29 (34) |
| *Perognathus amplus* | | 0.43 (5) | | 0.43 (5) |
| *Perognathus baileyi* | | 1.63 (19) | 0.79 (5) | 2.42 (24) |
| *Perognathus intermedius* | 1.5 (15) | 3.86 (45) | 2.69 (17) | 8.05 (77) |
| *Perognathus longimembris* | 0.5 (5) | | | 0.50 (5) |
| *Perognathus penicillatus* | 1.0 (10) | | | 1.00 (10) |
| *Peromyscus eremicus* | 0.3 (3) | 0.26 (3) | 2.53 (16) | 3.09 (22) |
| *Neotoma albigula* | 1.6 (16) | 1.80 (21) | 1.42 (9) | 4.82 (46) |
| *Neotoma lepida* | 0.6 (6) | 0.60 (7) | | 1.20 (13) |
| *Ammospermophilus harrisi* | 0.7 (7) | 0.17 (2) | | 0.87 (9) |
| *Sylvilagus auduboni* | | 0.09 (1) | | 0.09 (1) |
| **TOTALS** | | | | |
| Relative density | 8.8 | 9.53 | 7.43 | |
| Number of trap nights | 2,700 | 3,150 | 1,710 | 7,560 |
| Number of animals caught | 88 | 111 | 47 | 246 |
| Number of species | 8 | 9 | 4 | 11 |

alluvial outwash. Its numbers were reduced in foothill situations and nonexistent on hillsides. In contrast, the rock pocket mouse was found at higher densities in desert foothills where rock talus was prevalent, and the cactus mouse exhibited habitat preference for the rock outcrops present on desertscrub hillsides.

Simple monotypic vegetation types, such as creosote flats of the Lower Colorado community, typically support a small number of abundant species. Creosote flat habitat accounted for the third highest total relative density, but only four species were collected. The highest density for Arizona pocket mouse (Perognathus amplus) and the second highest density for Merriam's kangaroo rat were recorded in creosote communities.

Eight species were snap trapped in desert grasslands. The highest densities for white-throated woodrat, cactus mouse, deer mouse (Peromyscus maniculatus), and southern grasshopper mouse (Onychomys torridus) were recorded here. This indicates a trend where cricetid rodents appear to displace the heteromyid rodents and occur at higher densities in more mesic habitats, such as grasslands. Bradley and Mauer (1973) report that food habits of desert rodents tend to be generalized, i.e. small mammals utilize basic food types such as seeds, forbs, and arthropods depending upon seasonal availability. However succulence, usually in the form of green forbs or insects, is necessary in the diet of sciurid and cricetid species in contrast to the heteromyids, which only resort to succulence during the reproductive season (Bradley and Mauer 1973). Supplementary water may be important to most cricetids but another factor governing the distribution and abundance of small mammals in desert grasslands may be the availability of cover. Life-form of the vegetation dictates the amount and type of cover and food available and may be more important than the mere presence or absence of certain plant species. It was on this assumption that desert grassland was split into two standard habitat sites. It was thought that in a habitat where a vegetational canopy is lacking, that more may be provided in the way of cover from rock outcrops. This is better illustrated in Table 9 where densities for cactus mouse were found to be higher in areas with rock outcrop, than those without. Densities were also significantly higher for white-throated woodrat in rock outcrop associations due to the increased availability of suitable nesting sites. In addition, the eastern cottontail (Sylvilagus floridanus) was first observed in desert grasslands. It is sympatric with desert cottontail here, but occurs in greater numbers. It is generally found to be abundant from 2,600 feet to higher elevations of 5,200 feet in chaparral.

The highest densities for Ord's kangaroo rat (Dipodomys ordi) and Stephen's woodrat (Neotoma stephensi) were recorded in chaparral habitat. Six other species were snap trapped in this community with white-throated woodrat being the most abundant (1.80). Additionally, the white-footed mouse (Peromyscus leucopus) was found only in chaparral and its riparian counterpart of mixed broadleaf. Also, the brush mouse (Peromyscus boylei) and northern grasshopper mouse (Onychomys leucogaster) were only collected here and it was the only sight locality for mountain lion (Felis concolor).

Table 9. SMALL MAMMAL DENSITIES FOR DESERT GRASSLAND COMMUNITIES. DATA ARE SHOWN AS NUMBER OF ANIMALS CAPTURED PER 270 TRAP NIGHTS AND PARENTHESES INDICATE TOTAL NUMBER TRAPPED.

| Species | Desert Grassland | Desert Grassland With Rock Outcrop | Totals |
|---|---|---|---|
| *Dipodomys merriami* | 0.20 (1) | 0.33 (1) | (2) 4.13 |
| *Peromyscus eremicus* | 0.80 (4) | 3.33 (10) | (14) 0.40 |
| *Peromyscus maniculatus* | 0.40 (2) | | (2) 0.67 |
| *Onychomys torridus* | | 0.67 (2) | (2) 8.47 |
| *Neotoma albigula* | 1.80 (9) | 6.67 (20) | (29) 0.33 |
| *Neotoma lepida* | | 0.33 (1) | (1) 0.33 |
| *Neotoma stephensi* | | 0.33 (1) | (1) 0.20 |
| *Sylvilagus floridanus* | 0.20 (1) | | (1) 0.53 |

TOTALS

| | | | |
|---|---|---|---|
| Relative density | 3.4 | 11.66 | |
| Number of trap nights | 1,350 | 810 | 2,160 |
| Number of animals caught | 17 | 35 | 52 |
| Number of species | 5 | 6 | 8 |

Many small mammals, heteromyid rodents in particular, may live out their entire life span without ever drinking free water. They have evolved to meet water requirements through metabolism of carbohydrates. Water conservation in these rodents is enhanced by an efficient renal system which can concentrate urine, a lack of sweat glands, and their nocturnal habits. It is these factors which render riparian areas insignificant to most small mammals. The three remaining habitats considered, mixed broadleaf, cottonwood/willow, and mesquite bosques, all reported low density values and reduced species numbers. However, these areas are important for one of the smallest mammals present in the state, the desert shrew (Notiosorex crawfordi). All nine locality records were obtained from the use of can traps in mixed riparian scrub at 1,680 feet up to mixed broadleaf communities at 5,100 feet. Pocket gophers (Thomomys bottae) also heavily utilized riparian areas. Their burrows were frequently encountered along stream banks and over many of the flood plains adjacent to both perennial and intermittent drainages. This type of habitat was also observed to be significant to bats and larger mammals such as mustelids, procyonids, deer and javelina which periodically visit perennial water sources.

Arizona has more different kinds of bats than any other state in the union, 26 species within three families (Cockrum 1960). In sampling with mist nets and .22 cal. birdshot, we were able to account for 10 species over both planning units (Table 4). Abandoned dwellings, rock crevices, cattle tanks, trees, caves, and especially abandoned mines were important forage and roosting sites. Numerous mine shafts and tunnels occur throughout the planning units. These apparently represent significant habitat and were heavily utilized by bats. Large colonies, with up to several different species, were discovered in almost every mine tunnel sampled.

# DISCUSSION

In summary, mixed riparian scrub and Arizona Upland appear to be the most productive habitats for small mammals in the Black Canyon and Skull Valley Planning Units. The highest relative densities and the highest number of species for all communities considered were found here (Fig. 2). Presumably, this is in response to the diversity of habitat, where life-form of the vegetation and substrate vary greatly. The majority of the 338,000 acres surveyed over both planning units consisted of desertscrub foothills that were highly braided by intermittent washes. Mixed riparian scrub and Arizona Upland scrub therfore represent considerable habitat for the endemic small mammals. This is consistent with the results of Schwartzmann et al. (1975). They reported similar high mammal diversity and density values for desertscrub in their study of the Proposed Salt-Gila Aqueduct Site in central-Arizona.

Desert grassland and creosote communities were intermediate in their utilization by small mammals. Creosote flats were found to support few species at high population numbers. This was comparative to the results of Bradley and Mauer (1973) in their study of similar habitat in southern Nevada.

Riparian communities such as mixed broadleaf and mesquite bosques were the least productive habitats sampled. The lowest relative densities and number of species were recorded here. Perennial waters are of little consequence to many of the small mammals which have the ability to obtain their water metabolically. As a result, riparian areas do not represent significant habitat to these mammals and in terms of diversity and relative density, they typically support depauperate populations.

The white-throated woodrat, Merriam's kangaroo rat, rock pocket mouse, and cactus mouse were the four most frequently collected species on both planning units and therefore reported the highest relative densities (Fig. 3). Their total relative densities and habitat utilization are listed in Table 10. Information from this study revealed that mammal species are not restricted to given habitats, but overlap to form a continuum of distribution and should be managed accordingly. Coexistence of species depends on the ability of each population to delineate and segregate niche space. This may be achieved by different activity patterns (either diurnal or seasonal), by subdivision of the habitat, or by subdivision of the community resources. All tend to reduce shared habitat and resource utilization between species.

A listing has been compiled in Appendix 5 for mammal species known to occur within the Black Canyon and Skull Valley Planning Units, but whose presence was not substantiated by capture or observation through-

Fig. 2. Comparison of relative densities and number of species for the eight major vegetative communities within the Black Canyon/Skull Valley planning units.

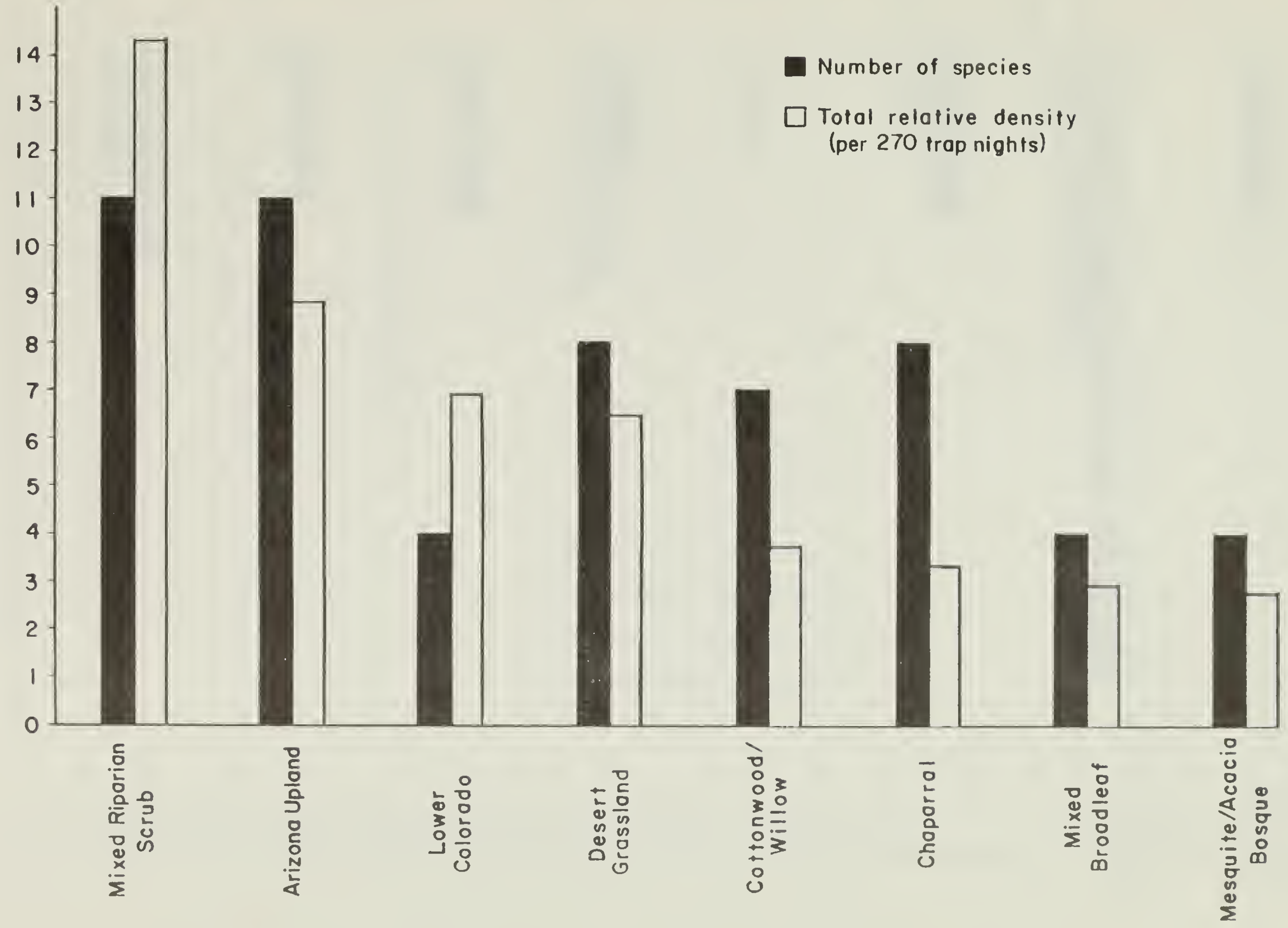

Fig. 3. Comparison of relative densities for the four most frequently collected species in eight standard habitat sites within the Black Canyon/Skull Valley planning units.

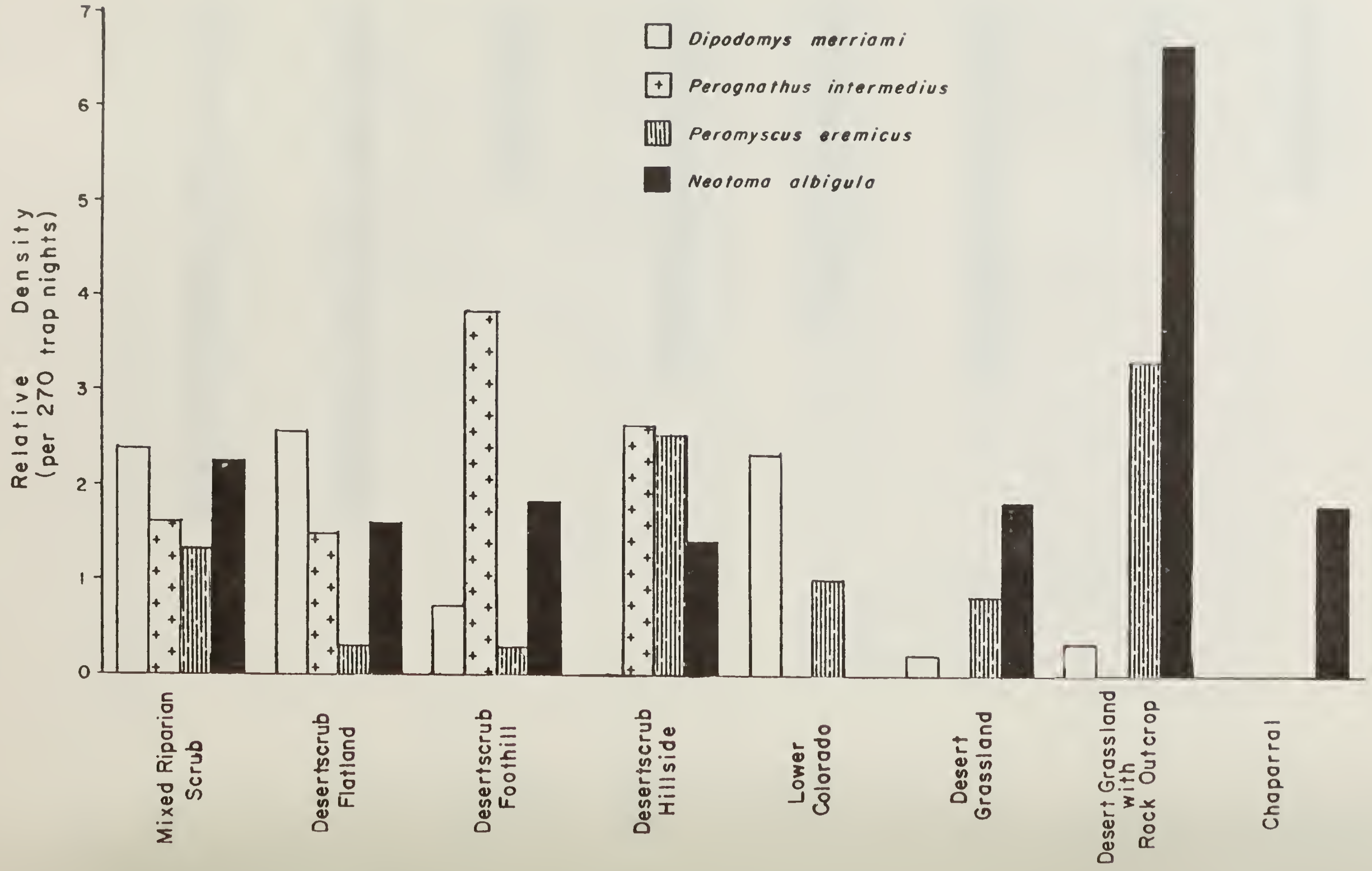

Table 10. TOTAL RELATIVE DENSITY AND HABITAT UTILIZATION OF THE MOST FREQUENTLY COLLECTED SPECIES. DATA ARE SHOWN AS NUMBER OF ANIMALS CAPTURED PER 270 TRAP NIGHTS AND PARENTHESES INDICATE TOTAL NUMBER TRAPPED.

| | Total Relative Density | No. of Habitats Found in Versus Total No. of Habitats |
|---|---|---|
| *Neotoma albigula* | 11.32 (102) | 9/11 |
| *Dipodomys merriami* | 7.56 (61) | 8/11 |
| *Perognathus intermedius* | 6.36 (93) | 6/11 |
| *Peromyscus eremicus* | 6.15 (50) | 9/11 |

out the present course of study. Of the 50 total mammal species either collected or observed during the sample period, none were either federally or state listed as being threatened or endangered. Only one species, the pocketed free-tailed bat (Tadarida femorosacca), exhibited a major range extension. It is normally found in Baja and northern Mexico and in southern California and Arizona (Hall and Kelson 1959). Locality records for Arizona are primarily from Pima, Santa Cruz, and part of Cochise County, but one specimen was collected approximately eight miles northwest of Lake Pleasant in Yavapai County. Whether this represents a population trend or an isolated instance is unknown at this time.

As a final note, population estimates are based on the probability of capture remaining constant for removal as well as mark and release trapping (Hayne 1949). Several parameters are involved which can make trapping selective and affect trapping success. They include the number, kind, size, and placement of traps; type of bait; weather; moonlight; inadvertent snapping of traps by cows and burros; unavailability of snapped traps; and age, sex, size, reproductive condition, and activity pattern of the species involved.

In regards to seasonal activity, most small mammals exhibit a bimodal pattern of spring and fall peaks separated by periods of dormancy and aestivation (Lewis 1972, M'Closkey 1972, Reichman and Van de Graaff 1973, Anderson, et al. 1977). Evaluation of habitat in terms of densities and diversities for various mammal populations should be made relative to the seasonal activity periods of the species involved.

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Appendix 1. LOCATIONS AND ELEVATIONS OF RECORDING STATIONS USED FOR CLIMATOLOGICAL DATA.

| | |
|---|---|
| Cordes | Yavapai County<br>34° 18' latitude<br>112° 10' longitude<br>Elevation - 3773'<br>means for period 1941-1970 |
| Castle Hot Springs | Yavapai County<br>33° 59' latitude<br>112° 22' longitude<br>Elevation - 1990'<br>means for period 1959-1970 |
| Wickenburg | Maricopa County<br>33° 58' latitude<br>112° 44' longitude<br>Elevation - 2095'<br>means for period 1941-1970 |
| Skull Valley | Yavapai County<br>34° 30' latitude<br>112° 41' longitude<br>Elevation - 4254' |
| Hillside | Yavapai County<br>34° 25' latitude<br>112° 55' longitude<br>Elevation - 3845'<br>means for period 1941-1954 |

Appendix 2. BLACK CANYON/SKULL VALLEY STANDARD HABITAT SITES (Numbered).

Upper Sonoran Life-zone

1. Chaparral
2. Desert Grassland
3. Desert Grassland with Rock Outcrop

Lower Sonoran Life-zone

Sonoran Desertscrub

4. Lower Colorado

Arizona Upland

5. Desertscrub Flatland
6. Desertscrub Foothill
7. Desertscrub Hillside

Riparian Deciduous Woodland

8. Mesquite/Acacia Bosque
9. Mixed Broadleaf
10. Cottonwood/Willow
11. Mixed Riparian Scrub

Appendix 3. BLACK CANYON PLANNING UNIT MAMMAL TRANSECT LOCALITIES.

Mammal Grid #1
AZ., Maricopa Co. T5N R1E NW1/4 Sec. 30, elev. 1400'

Mammal Grid #2
AZ., Maricopa Co. T5N R1W SE1/4 Sec. 21, elev. 1450'

Mammal Grid #3
AZ., Maricopa Co. T5N R1E SW1/4 Sec. 19, elev. 1560'

Mammal Grid #4
AZ., Maricopa Co. T5N R1W NW1/4 Sec. 25, elev. 1400'

Mammal Grid #5
AZ., Maricopa Co. T6N R1W SW1/4 Sec. 23, elev. 1800'

Mammal Grid #6
AZ., Maricopa Co. T7N R1W NE1/4 Sec. 35, elev. 1840'

Mammal Grid #7
AZ., Maricopa Co., French Creek flood plain
T7N R1W NE1/4 Sec. 13, elev. 1800'

Mammal Grid #8
AZ., Yavapai Co. T7N R2E NW1/4 Sec. 33, elev. 2080'

Mammal Grid #9
AZ., Maricopa Co. T6N R1E NW1/4 Sec. 35, elev. 1660'

Mammal Grid #10
AZ., Yavapai Co., Agua Fria River flood plain
T7N R1E SW1/4 Sec. 12, elev. 1680'

Mammal Grid #11
AZ., Maricopa Co. T8N R2E SE1/4 Sec. 32, elev. 1760'

Mammal Grid #12
AZ., Yavapai Co. T7N R1E SW1/4 Sec. 4, elev. 2080'

Mammal Grid #13
AZ., Maricopa Co. T6N R2W SW1/4 Sec. 35, elev. 1840'

Mammal Grid #14
AZ., Maricopa Co. T6N R1W SW1/4 Sec. 18, elev. 2300'

Mammal Grid #15
AZ., Maricopa Co., Morgan City Wash
T7N R2W SE1/4 Sec. 25, elev. 2520'

Mammal Grid #16
AZ., Maricopa Co. T6N R2W SW1/4 Sec. 22, elev. 2300'

Mammal Grid #17
AZ., Maricopa Co., Picacho Wash
T6N R2W NE1/4 Sec. 9, elev. 2300'

Mammal Grid #18
AZ., Maricopa Co. T6N R1W NE1/4 Sec. 34, elev. 1800'

Mammal Grid #19
AZ., Maricopa Co. T6N R2W SW1/4 Sec. 7, elev. 2180'

Mammal Grid #20
AZ., Maricopa Co. T7N R3W NW1/4 Sec. 35, elev. 2440'

Mammal Grid #23
AZ., Yavapai Co. T7N R1E SW1/4 Sec. 10, elev. 1780'

Mammal Grid #24
AZ., Maricopa Co., New River flood plain
T6N R2E NW1/4 Sec. 20, elev. 1750'

Mammal Grid #25
AZ., Maricopa Co. T7N R2E NE1/4 Sec. 16, elev. 2360'

Mammal Grid #26
AZ., Maricopa Co. T6N R2E NE1/4 Sec. 7, elev. 1860'

Mammal Grid #27
AZ., Yavapai Co. T7N R1E NE1/4 Sec. 11, elev. 2000'

Mammal Grid #28
AZ., Yavapai Co., Humbug Creek flood plain
T7N R1E SE1/4 Sec. 17, elev. 1680'

Mammal Grid #29
AZ., Yavapai Co., French Creek flood plain
T7N R1W NW1/4 Sec. 24, elev. 1700'

Mammal Grid #30
AZ., Yavapai Co. T7N R1E NW1/4 Sec. 19, elev. 1800'

Mammal Grid #31
AZ., Yavapai Co. T8N R1W NW1/4 Sec. 36, elev. 2240'

Mammal Grid #32
AZ., Yavapai Co. T8N R1W NE1/4 Sec. 28, elev. 2480'

Mammal Grid #33
AZ., Yavapai Co. T8N R1W SE1/4 Sec. 30, elev. 2400'

Mammal Grid #34
AZ., Yavapai Co., Cedar Basin
T7N R2W SW1/4 Sec. 12, elev. 2640'

Mammal Grid #35
AZ., Yavapai Co. T8N R1W NE1/4 Sec. 11, elev. 2760'

Mammal Grid #36
AZ., Yavapai Co., Silver Creek
T9N R1W NE1/4 Sec. 16, elev. 4260'

Mammal Grid #37
AZ., Yavapai Co. T9N R1W SW1/4 Sec. 28, elev. 3800'

Mammal Grid #38
AZ., Yavapai Co. T7N R2W NE1/4 Sec. 9, elev. 3040'

Mammal Grid #39
AZ., Maricopa Co. T7N R2W NE1/4 Sec. 19, elev. 3120'

Mammal Grid #43
AZ., Yavapai Co. T11N R2E SE1/4 Sec. 17, elev. 3960'

Mammal Grid #44
AZ., Yavapai Co. T11N R2E NE1/4 Sec. 34, elev. 3840'

Mammal Grid #48
AZ., Yavapai Co. T11N R3E SW1/4 Sec. 19, elev. 3600'

Mammal Grid #49
AZ., Yavapai Co., Agua Fria River
T10N R3E NE1/4 Sec. 17, elev. 3240'

Mammal Grid #53
AZ., Yavapai Co. T11N R3W SW1/4 Sec. 6, elev. 4480'

Mammal Grid #61
AZ., Yavapai Co. T10N R3E NW1/4 Sec. 22, elev. 3740'

Mammal Grid #62
AZ., Yavapai Co., Indian Creek
T10N R3E NE1/4 Sec. 4, elev. 3360'

Mammal Grid #63
AZ., Yavapai Co. T10N R2E NE1/4 Sec. 2, elev. 3600'

Mammal Grid #64
AZ., Yavapai Co., Agua Fria River/Ash Creek flood plain
T11N R3E SW1/4 Sec. 17, elev. 3510'

Mammal Grid #65
AZ., Yavapai Co. T13N R2E SW1/4 Sec. 6, elev. 4920'

Mammal Grid #66

AZ., Yavapai Co., Chaparral Gulch
T13N R1E SE1/4 Sec. 19, elev. 5120'

Mammal Grid #67

AZ., Yavapai Co.  T12N R1E NE1/4 Sec. 23, elev. 4560'

Mammal Grid #68

AZ., Yavapai Co.  T12N R2E NE1/4 Sec. 29, elev. 4120'

Mammal Grid #69

AZ., Yavapai Co.  T12N R2E SW1/4 Sec. 4, elev. 4440'

Mammal Grid #70

AZ., Yavapai Co.  T13N R1E SW1/4 Sec. 24, elev. 4880'

## Appendix 4. SKULL VALLEY PLANNING UNIT MAMMAL TRANSECT LOCALITIES.

Mammal Grid #54
AZ., Yavapai Co. T11N R4W NE1/4 Sec. 27, elev. 4880'

Mammal Grid #55
AZ., Yavapai Co. T9N R5W NW1/4 Sec. 19, elev. 2800'

Mammal Grid #56
AZ., Yavapai Co. T10N R5W SW1/4 Sec. 30, elev. 3140'

Mammal Grid #57
AZ., Yavapai Co. T10N R5W NW1/4 Sec. 24, elev. 4000'

Mammal Grid #58
AZ., Yavapai Co. T9N R5W NW1/4 Sec. 24, elev. 2985'

Mammal Grid #59
AZ., Yavapai Co. T8N R4W SE1/4 Sec. 19, elev. 2480'

Mammal Grid #71
AZ., Yavapai Co. T8N R5W SE1/4 Sec. 10, elev. 2540'

Mammal Grid #72
AZ., Maricopa Co. T7N R4W NW1/4 Sec. 15, elev. 2320'

Mammal Grid #73
AZ., Yavapai Co. T8N R4W SW1/4 Sec. 1, elev. 3040'

Mammal Grid #74
AZ., Yavapai Co., Martinez Creek
T9N R6W NE1/4 Sec. 1, elev. 2900'

Mammal Grid #75
AZ., Yavapai Co. T8N R7W SE1/4 Sec. 14, elev. 2520'

Mammal Grid #76
AZ., Yavapai Co., Arrastre Creek flood plain
T11N R4W NE1/4 Sec. 26, elev. 4640'

Appendix 5. MAMMAL SPECIES POTENTIALLY INHABITING THE BLACK CANYON/SKULL VALLEY PLANNING UNITS, BUT UNREPORTED DURING THE SAMPLE PERIOD.

CHIROPTERA

VESPERTILIONIDAE

| | |
|---|---|
| Myotis lucifugus subsp. occultus | Little brown bat |
| Myotis volans | Long-legged myotis |
| Lasionycteris noctivagans | Silver-haired bat |
| Lasiurus borealis | Red bat |
| Lasiurus cinereus | Hoary bat |
| Euderma maculata | Spotted bat |

MOLOSSIDAE

| | |
|---|---|
| Tadarida brasiliensis | Brazilian free-tailed bat |
| Eumops perotis | Greater mastiff bat |

RODENTIA

SCIURIDAE

| | |
|---|---|
| Cynomys gunnisoni | Gunnison's prairie dog |

HETEROMYIDAE

| | |
|---|---|
| Perognathus flavus | Silky pocket mouse |

CRICETIDAE

| | |
|---|---|
| Sigmodon hispidus | Hispid cotton rat |

ERETHIZONTIDAE

| | |
|---|---|
| Erethizon dorsatum | Porcupine |

CARNIVORA

MUSTELIDAE

| | |
|---|---|
| Conepatus mesoleucus | Hog-nosed skunk |

ARTIODACTYLA

BOVIDAE

| | |
|---|---|
| * Ovis canadensis | Desert bighorn sheep |

* Historically known to occur within both planning units, but currently extirpated from the area.

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